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SUBJECT
Design Specification for a General Purpose
Data Integration and Display System (DIDS)

(NASA-CR-160207) DESIGN SPECIFICATION FOR A
GENERAL PURPOSE DATA INTEGRATION AND DISPLAY
SYSTEM (DIDS) (General Electric Co.) 82 p
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This report is a software design specification
for a general purpose Data Integration and
Display System (DIDS). Displays can be
presented on the Biomed Console CRT and/or
the COMLOT x-y plotter using output from
any FORTRAN or XSYMBOL program.

R. F. Hassell

Attachment
/db

CONCURRENCES

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DIDS DESIGN SPECIFICATION



1.0 PROGRAM PURPOSE AND SCOPE

The Data Integration and Display System (DIDS) will be a general purpose system to provide a capability for any program written in FORTRAN or XSYMBOL to display its output. Displays may be presented on the Biomed Console CRT, the ~~COMPL~~ X-Y plotter or both. Presentation of the displays may occur at "execute time" or may be stored on magnetic tape for display at a later time.

The display of data stored on magnetic tape will be accomplished without the necessity of coding a program. The Keyboard on the Biomed Console or the teletype will be the user's interface with DIDS to call displays stored on magnetic tape.

Using the biomed console or the teletype, the user may exercise control over the displays called from magnetic tape such as changing scale factors, changing alphanumeric notation and changing colors on curves.

2.0 PROGRAM DESCRIPTION

DIDS will provide programs to support two types of system users: the programmer who desires to control the system via FORTRAN or XSYMBOL software and the operator who wishes to perform functions via the keyboard. See paragraph 6.0 for a list of system options.

The programs required to support the operator are a subset of those required for programmer support except for the Keyboard Decoder Program described below. The following paragraphs describe the programs comprising DIDS.

The description of each program includes:

Calling Sequence - a list of the parameters transferred to a subprogram from the calling program.

Input - a list and description of the data the program is required to manipulate.

Output - a list and description of the data output to any of the system peripheral devices.

Computations - a description of the mathematical computations to be performed by the program.

Description - a narrative description of the functions performed by the program.

NOTE: In this specification, the term "keyboard" and "CRT" refers to the Keyboard and CRT on the Biomed Console unless otherwise stated.

2.1 EXECUTIVE LOOP PROGRAM (EXEC)

Calling Sequence: RCPYI P,L
 B EXEC

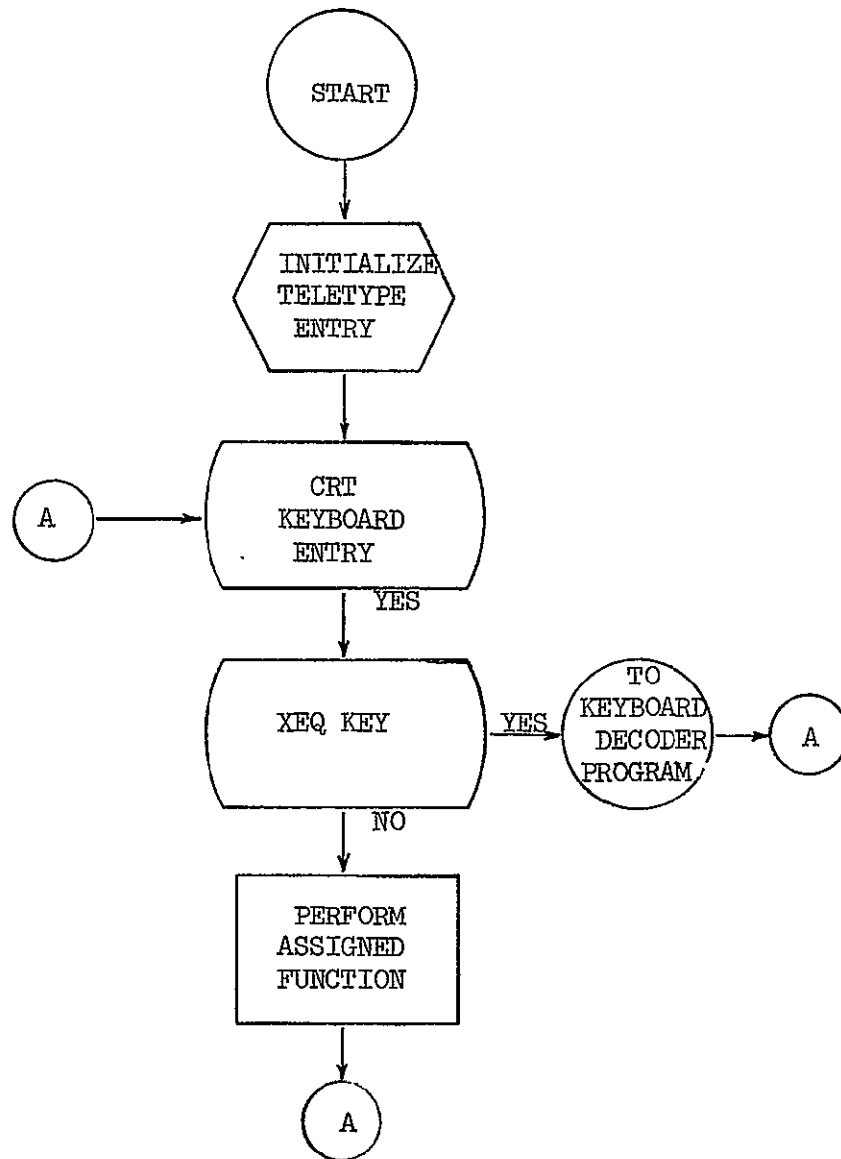
Input: Data from the CRT or the teletype requesting execution of one of the system functions.

Output: None

Computation: None

Description: EXEC will monitor the Biomed Console Keyboard and the teletype for control commands from the operator. Upon receipt of an operator command, the input characters will be stored in a fixed memory area and control will be transferred to the Keyboard Decoder Program.

EXEC



2.2 KEYBOARD DECODER PROGRAM (KBDEC)

Calling Sequence: RCPYI P,L
 B KBDEC

Input: Data from the CRT or the teletype requesting execution of one of the system functions. This data is stored in a fixed memory area in memory.

Output: An error message will be printed on the teletype if the command cannot be decoded.

Computation: None

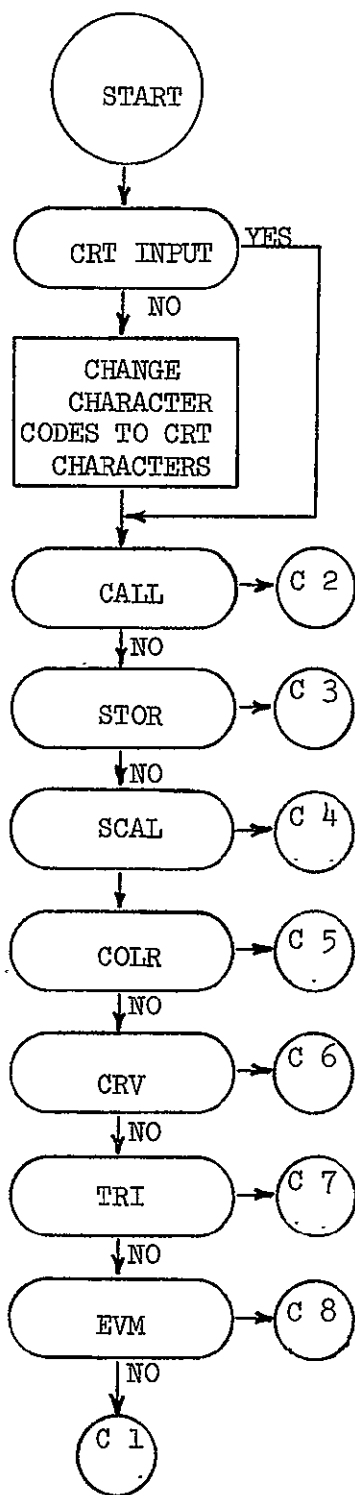
Description: KBDEC will transfer control to the proper program based on the command input from the Keyboard or teletype. Prior to transferring control, KBDEC must set flags indicating the source and destination of the data being manipulated.

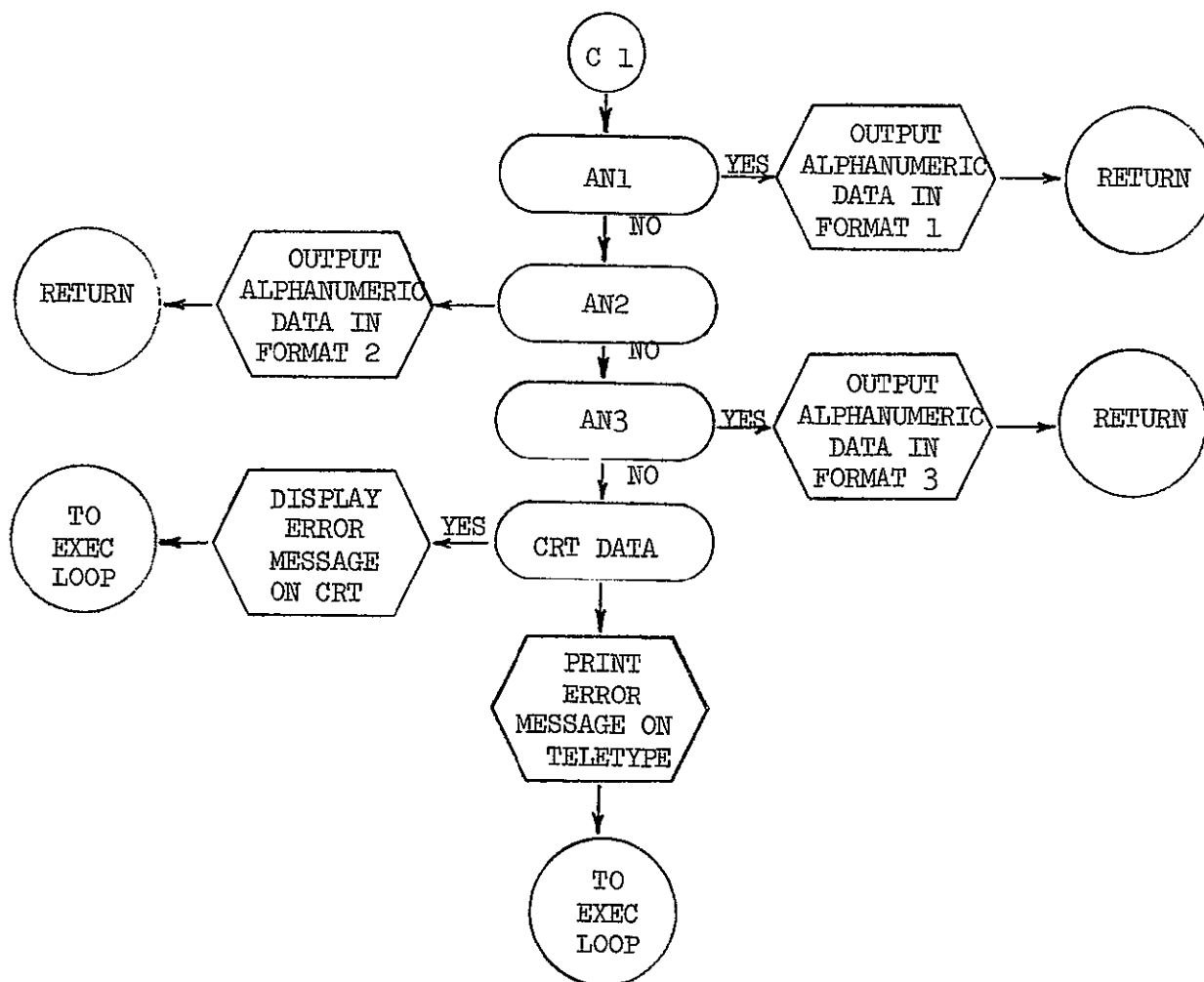
Following are the functions which may be requested by the operator via the keyboard.

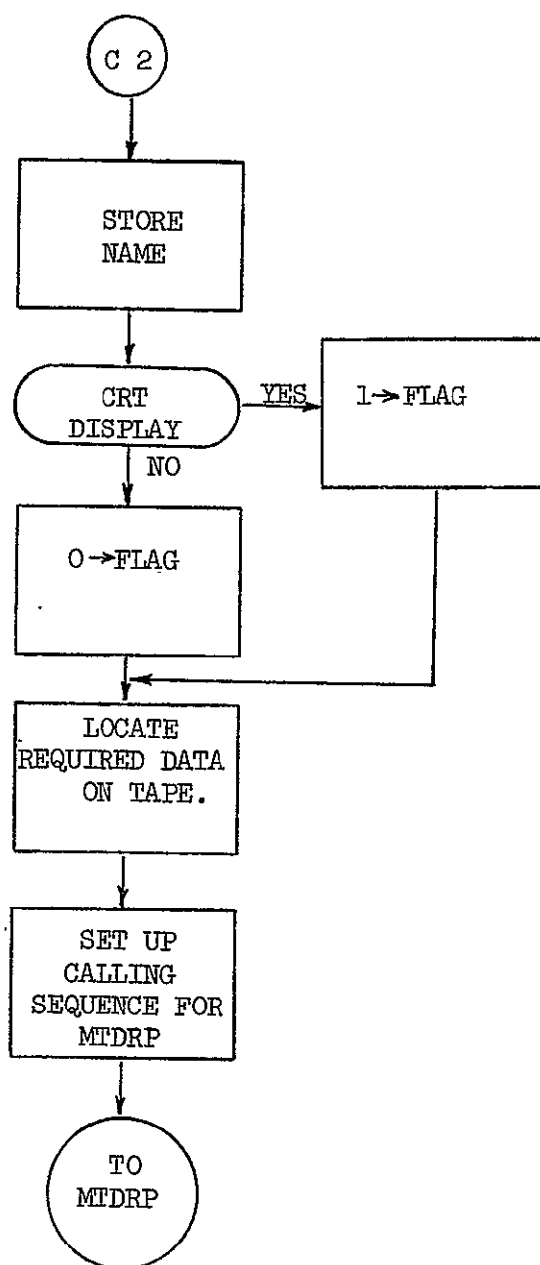
1. Call a display from magnetic tape and present it on the CRT or X-Y plotter.
2. Re-record a CRT or X-Y plotter display on magnetic tape. The data to be re-recorded must be either the current CRT display or the last X-Y plotter display.
3. Change the scaling of one of the axes of one of the curves on the CRT or X-Y plotter. The input scale factor must be an integer.
4. Change the color of one of the curves on the CRT.
5. Verify the operational condition of the display equipment. This will consist of operator commands to present an example of each type of CRT display or a line pattern on the X-Y plotter. This will provide a visual verification of the operational condition of the hardware.

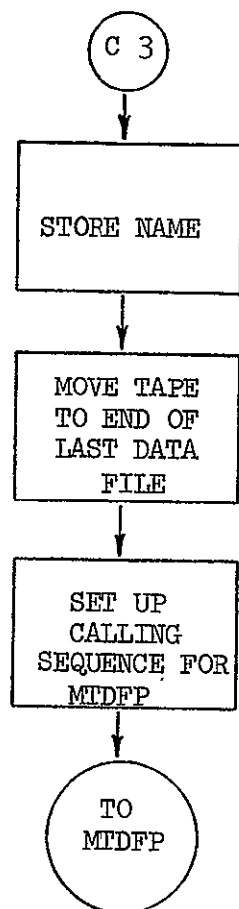
To perform the preceding functions, KBDEC will transfer control to one of the programs described in paragraphs 2.3, 2.4, 2.5, 2.6, or 2.7.

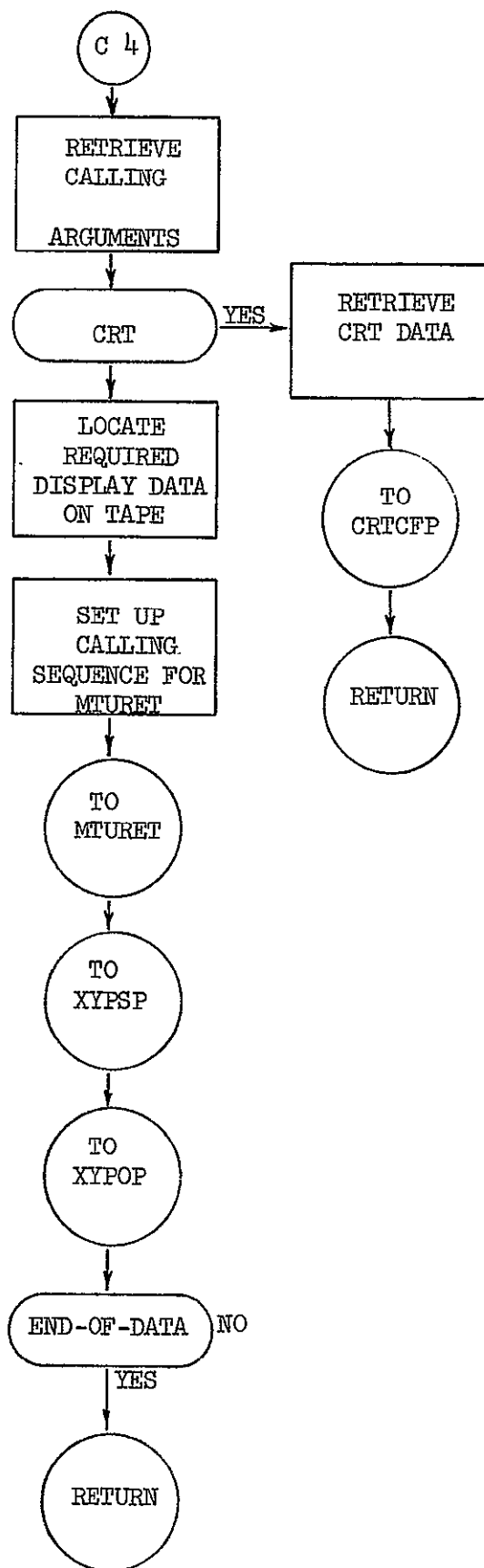
The structure of the operator command is described in paragraph 6.0 (Program Options).

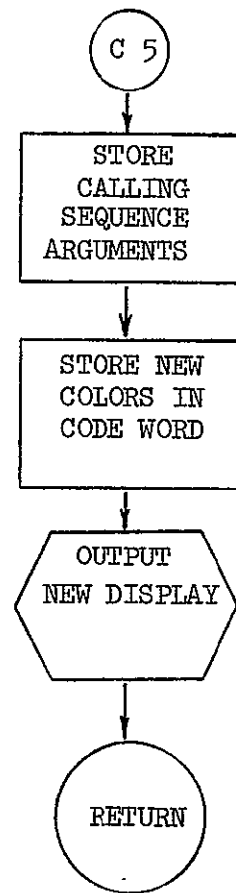
KBDEC

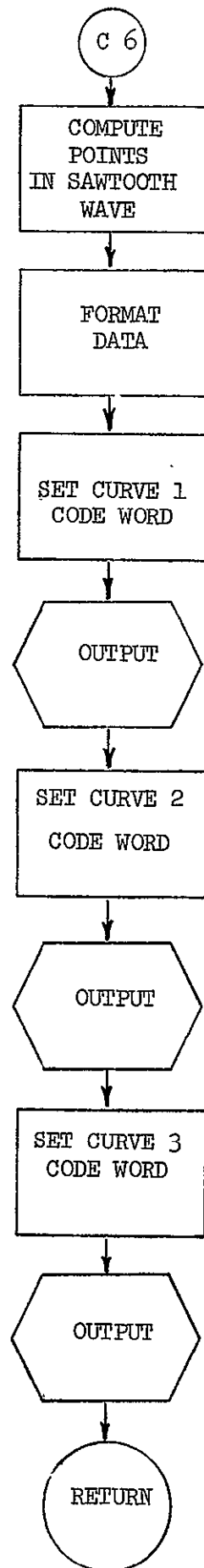


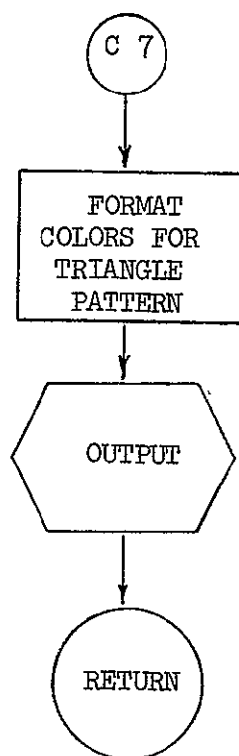


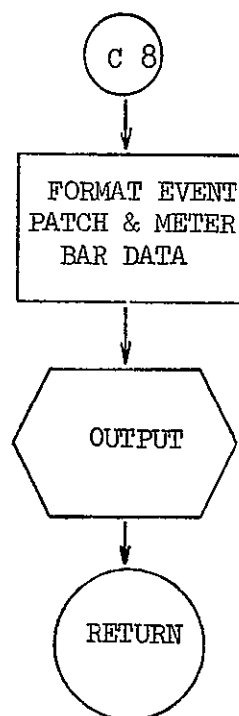












2.3 CRT DATA RETRIEVAL PROGRAM (CRTRET)

Calling Sequence: RCPYI P,L
 B CRTRET

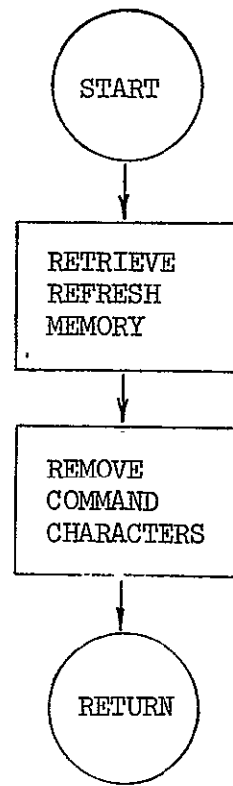
Input: The contents of the Biomed Console Refresh memory is input and stored in a fixed area of memory.

Output: None

Computation: None

Description: CRTRET will input the data from the Biomed Console refresh memory by calling the Biomed Console Input Program. The command data will be replaced by blanks and control transferred to the CRT Formatter and Scaling Program or the X-Y plotter Scaling Program. Control will be returned to the calling program.

CRTRET



2.4 DISK DATA RETRIEVAL PROGRAM (RADRET)

Calling Sequence:

CALL RADRET (Name, ICOUNT)

Name - the name of the array containing the name of the
file to retrieve

ICOUNT - the number of words to retrieve

Input: Retrieves the specified number of words from the named file
on the RAD in UD.

Output: An error message will be printed on the teletype if the
requested file cannot be found.

Computations: None

Description: RADRET will search its directory for the specified file
and will retrieve the requested number of words. Control will be
returned to the calling program.

The format of the file is described in Appendix B.

2.5 MAG TAPE DATA RETRIEVAL PROGRAM (MTURET)

Calling Sequence:

```
CALL MTURET (Name, ICOUNT)
```

 Name - the file name

 ICOUNT - the number of FORTRAN generated values to retrieve

Input: Retrieves the specified number of words from magnetic tape.

Output: An error message will be printed on the teletype if the requested file cannot be found.

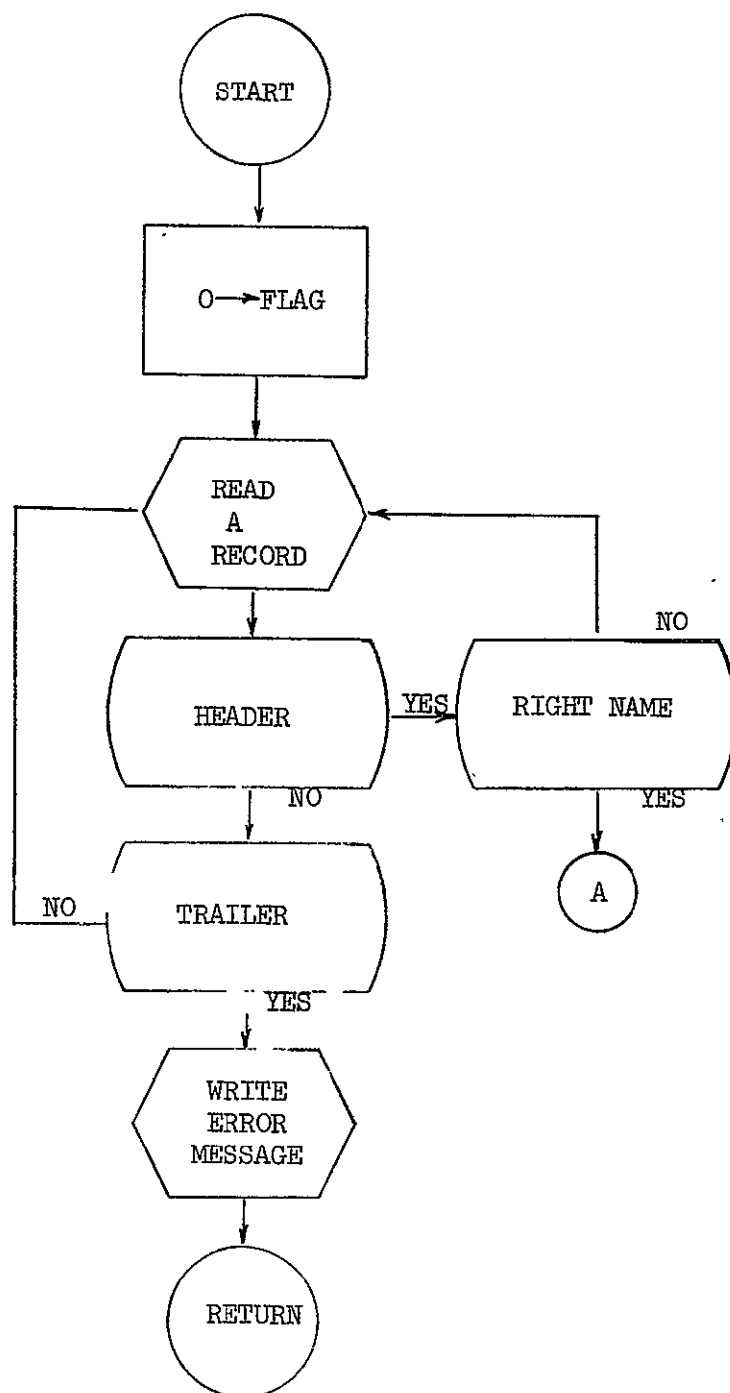
Computations: None

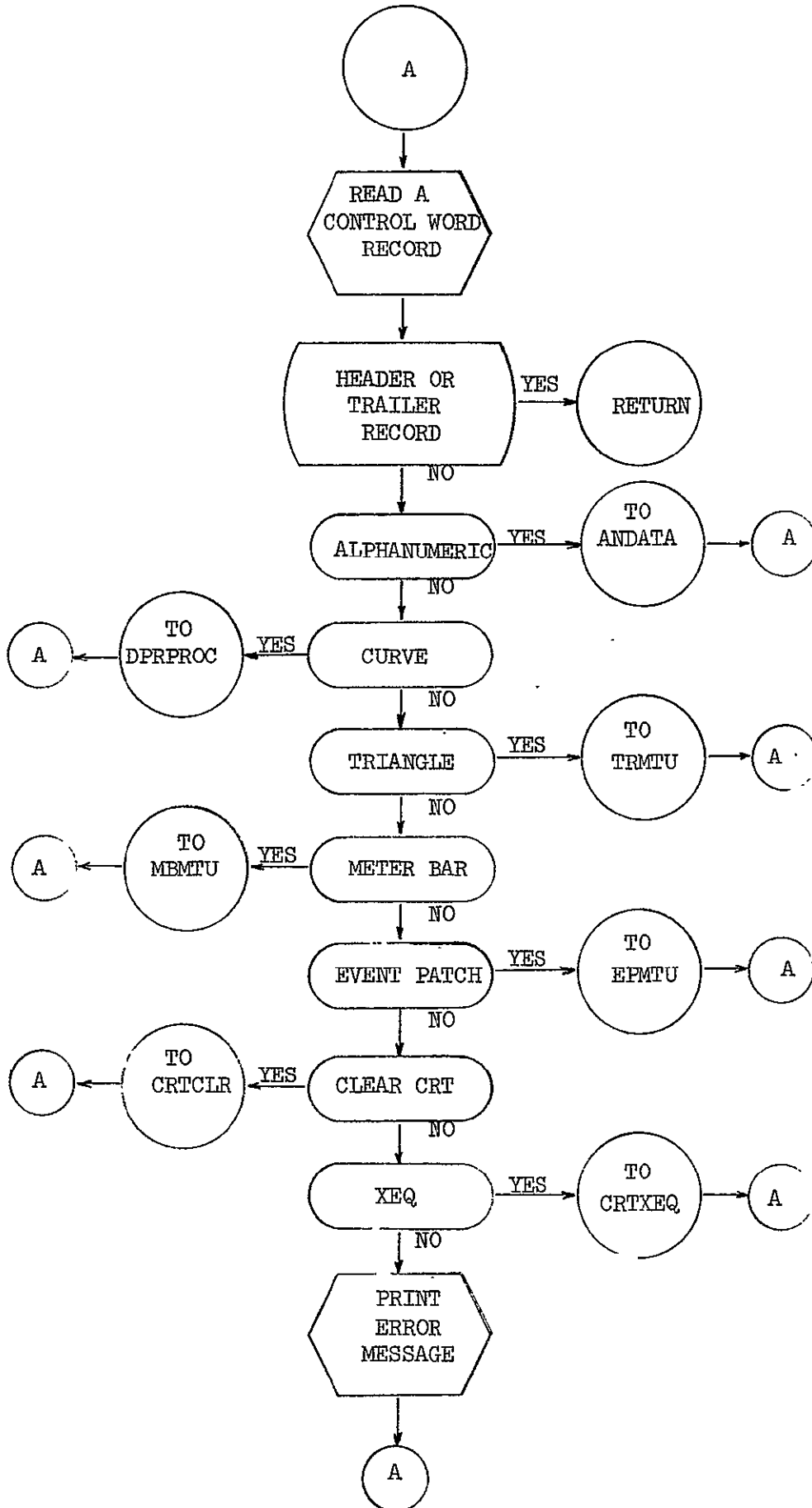
Description: MTURET will input the required data from magnetic tape.

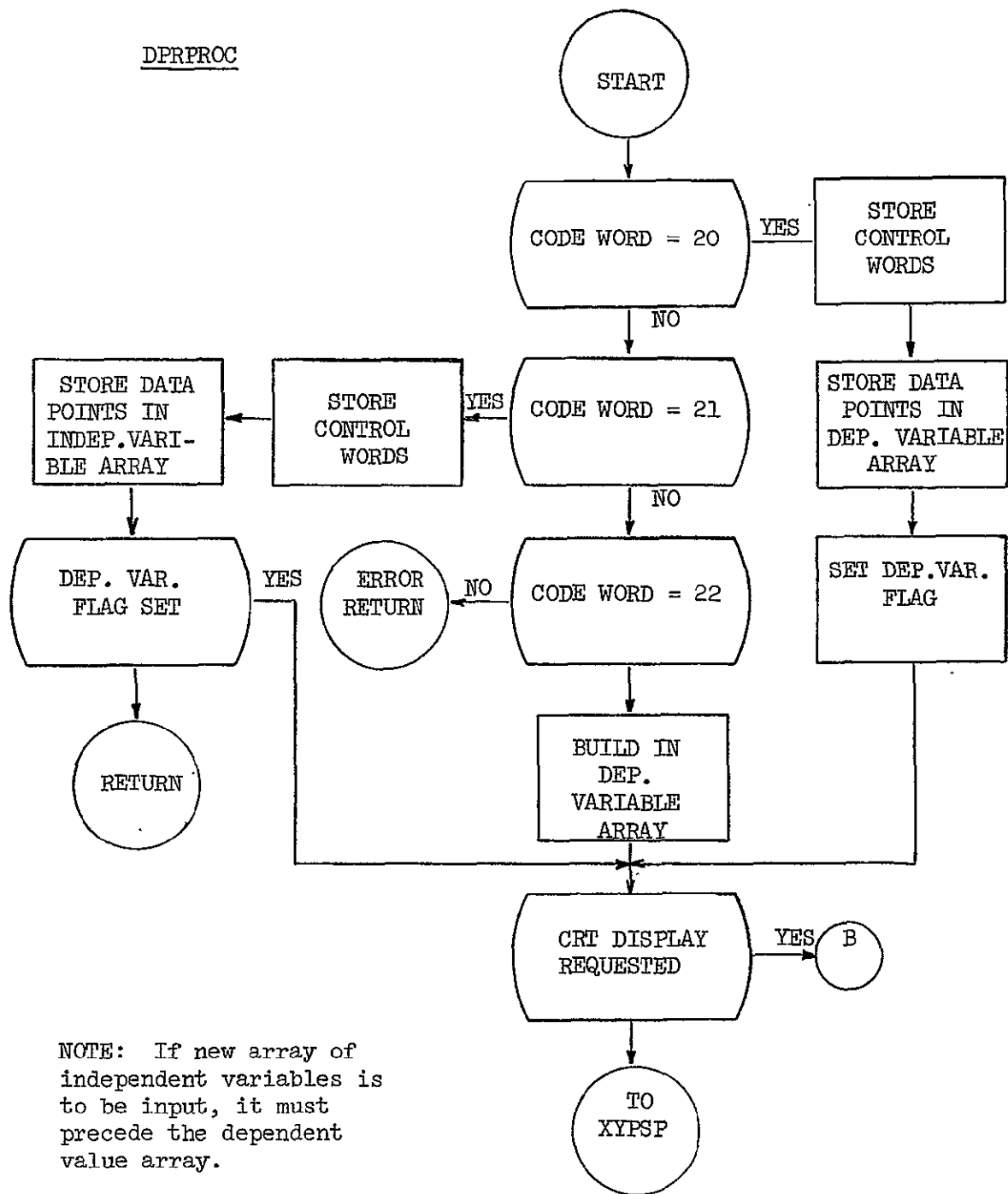
The proper file will be located by reading the header record of each file until the proper file is detected. (See Appendix A for a description of the mag tape formats). If the required file is not found, an error message will be printed on the teletype.

As stated in Appendix A, the data to plot must be in records of 256 floating point values or fewer.

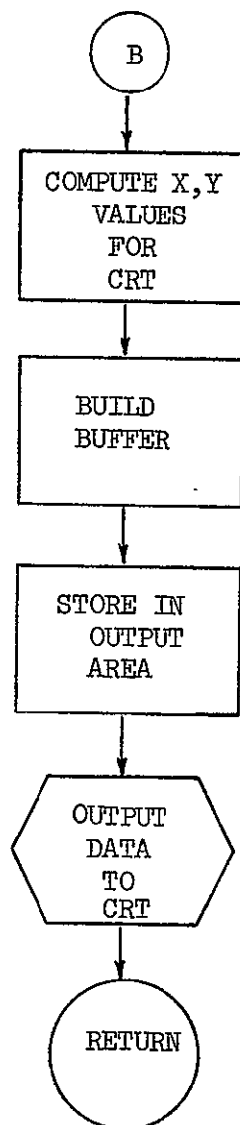
When the retrieval is complete, control is returned to the calling program.

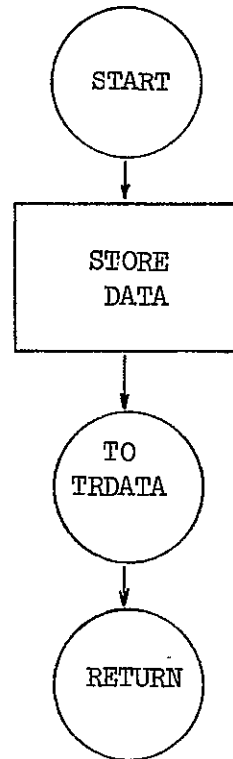
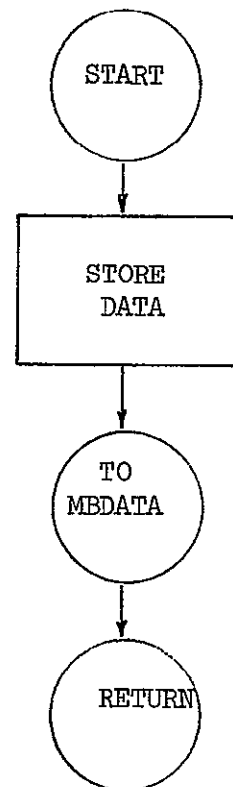
MTURET

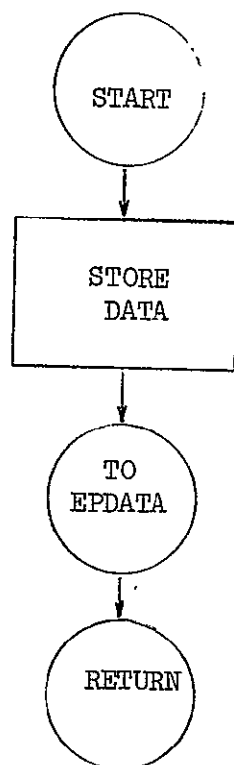
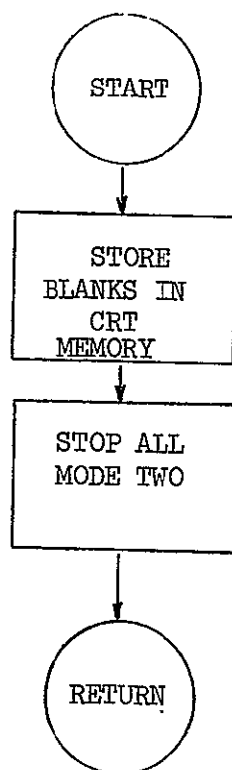


DPRPROC

NOTE: If new array of independent variables is to be input, it must precede the dependent value array.



FRMTUMBMTU

EPMTUCRTCLR

2.6 CARD READER DATA RETRIEVAL PROGRAM (CRDRET)

Calling Sequence:

Call CRDRET (INUM, AMAX, AMIN, DELTA, IPLØT, ICURV)

INUM = number of values (points to plot) to read from cards

AMAX = maximum data value

AMIN = minimum data value

DELTA = value (in engineering units) of .1 inch on X-Y plotter.

This argument is ignored if data is to be plotted on the CRT.

IPLØT = 1 - plot on X-Y plotter

= 0 - plot on CRT

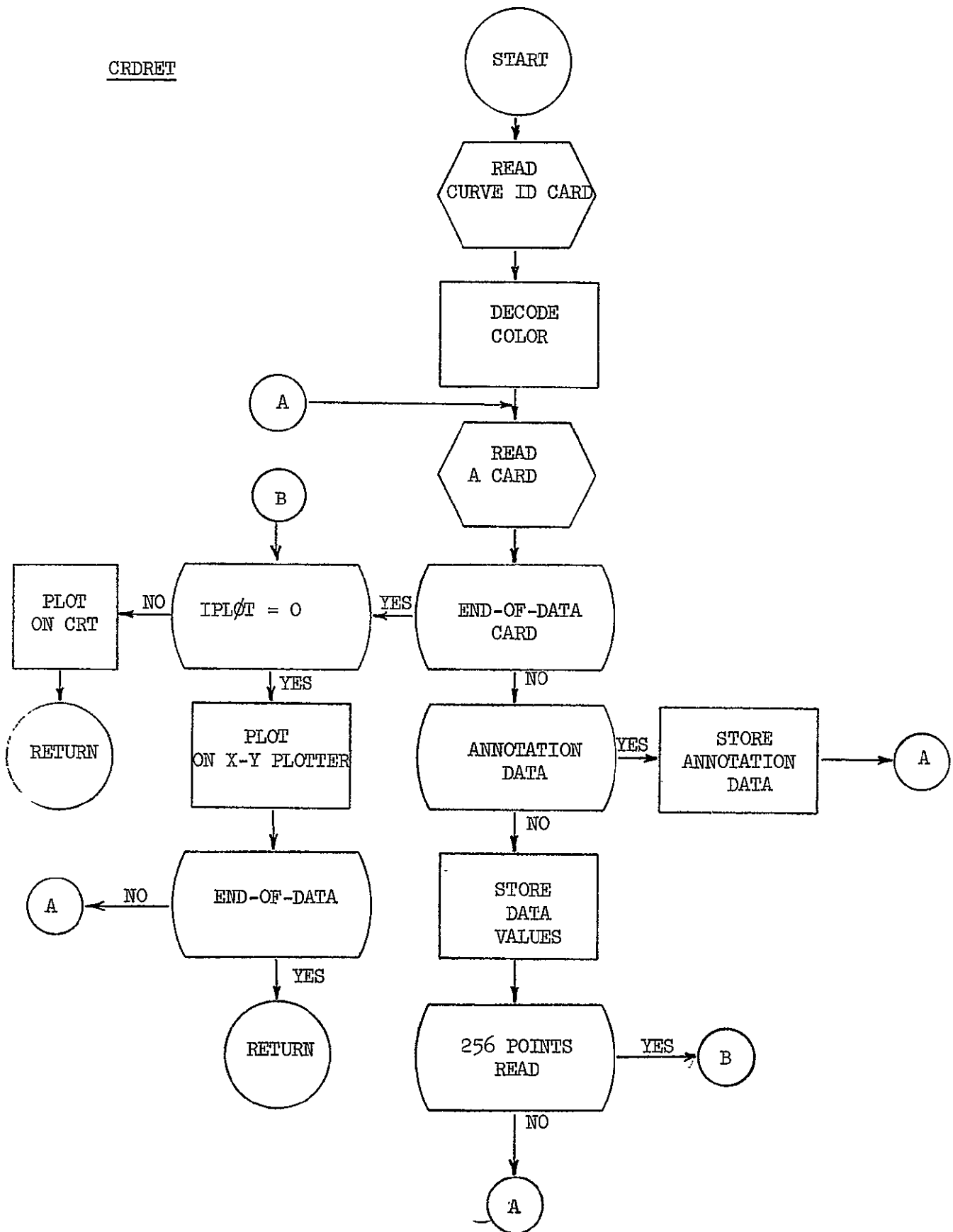
ICURV = indicates which curve on the CRT is to be used. This argument is ignored if data is to be plotted on X-Y plotter.

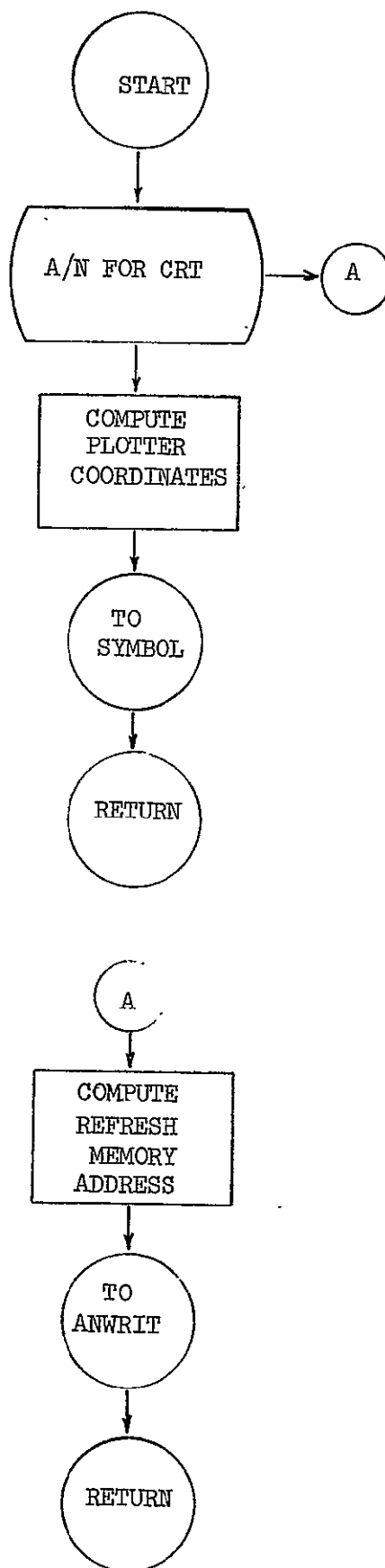
Input: Inputs the specified number of data point values from the card reader.

Output: An error message will be printed on the teletype if the calling program calls for more data point values than are available from the card reader.

Computations: None

Description: CRDRET will input the data and plot it. If the data is to be plotted on the CRT only the first 256₁₀ points will be read. If the data is to be plotted on the X-Y plotter, the data will be read and plotted in groups of 256 points.

CRDRET

ANDATA

2.7 HARDWARE DIAGNOSTIC PROGRAMS

The hardware diagnostic programs require no input and perform no calculations. Each program outputs a fixed pattern to its associated peripheral device. The calling sequence for each program is as follows:

```
RCPYI      1,2
B          XXXX
```

where XXXX is one of the following program names:

```
AN1
AN2
AN3
EVM
CRV
TRI
PLOT
```

Program Descriptions:

AN1 - Outputs a format 1 pattern on the CRT consisting of each character in the character set associated with the CRT. Format 1 displays three groups of ten characters on each line with spaces for event patches between the character groups.

AN2 - Outputs a format 2 pattern on the CRT consisting of each character in the character set associated with the CRT. Format 2 displays a group of ten characters and a group of 20 characters on each line with spaces for a meter bar between the character groups.

AN3 - Outputs a format 3 pattern on the CRT consisting of each character in the character set associated with the CRT. Format 3 displays one group of 30 characters on each line.

EVM - Outputs a display on the CRT consisting of meter bars and event patches.

CRV - Outputs three sawtooth waves on the CRT displayed on a grid.

TRI - Outputs the triangle pattern on the CRT with all possible colors displayed.

PLOT - Outputs the alphabet on the X-Y plotter along with a line drawing.

2.8 CRT Curve Scaling Program (CRTSP)

Calling Sequence:

Call CRTSP (DATAD, AMAX, AMIN, NUM, ANDATA, ICURV, LCOL, RCOL)

where DATAD = address of data to be displayed
 AMAX = maximum value to be displayed
 AMIN = minimum value to be displayed
 NUM = number of points to display ($\leq 256_{10}$)
 ANDATA = address of annotation data
 ICURV = which curve to display - 1, 2 or 3
 LCOL = left color
 RCOL = right color

Input: A set of unscaled FORTRAN generated floating point data point values and alphanumeric annotation for the display.

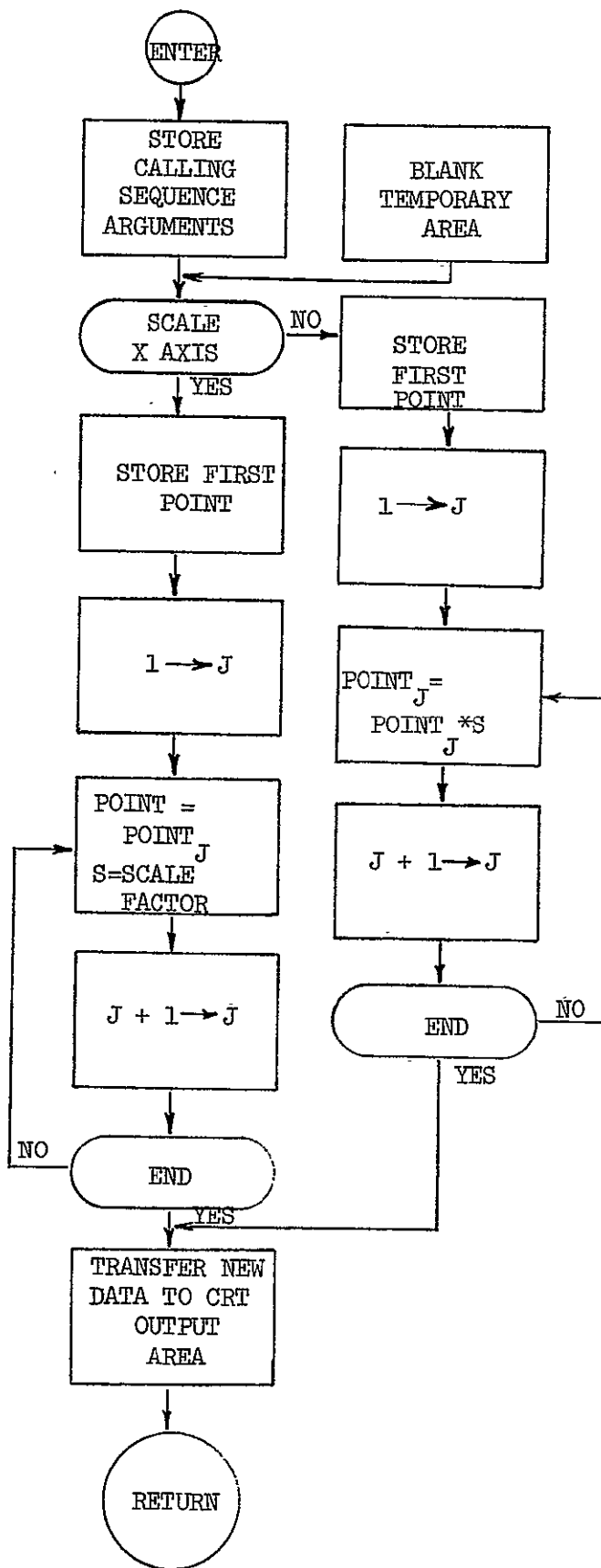
Output: A set of FORTRAN generated floating point data point values.

Calculations: A scale factor will be computed as follows:

$$\text{Scale factor} = \frac{140}{\text{max value} - \text{min value}}$$

The unscaled data points will be multiplied by the scale factor to form the scaled curve.

Description: CRTSP will compute the scale factor and scale the data and transfer control to the curve Formatter Program.

CRTSP

2.9 CRT CURVE FORMATTER PROGRAM (CRTCFP)

Calling Sequence:

Call CRTCFP (SCDATA, ANDATA, NUM, ICURV)

where SCDATA = address of scaled data to be displayed
 ANDATA = address of annotation data
 NUM = number of points to be displayed (≤ 256)
 ICURV = which curve to display - 1, 2, or 3

Input: A set of scaled FORTRAN generated floating point data point values and alphanumeric annotation for the display.

Output: A set of up to 256 data point values and alphanumeric annotation data formatted for direct transmission to the CRT.

Computations:

The curve data must be converted from FORTRAN floating point numbers to eight bit numbers transformed for CRT display. This conversion will be performed as follows:

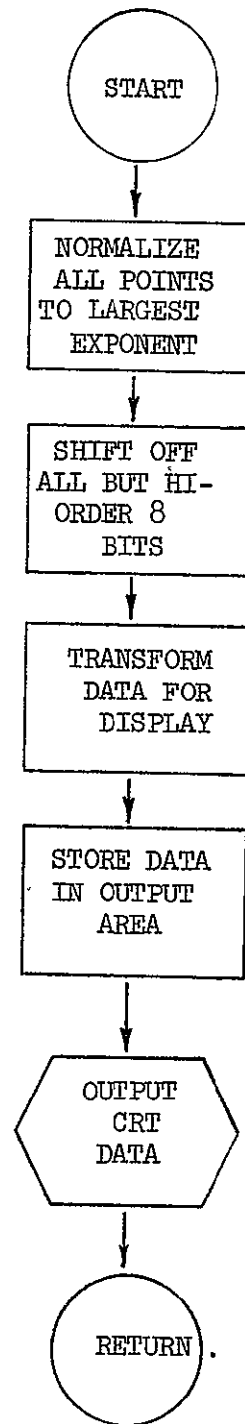
1. Normalize the FORTRAN numbers to the smallest exponent.
2. Shift off all but the high order eight bits of the mantissa.
3. Transform the normalized and shifted numbers as follows:

$$N_t = (145 - N) + 30$$

where N_t = transformed number
 N = untransformed number

Description: CRTCFP is an XSYMBOL program called by a FORTRAN program. The functions performed by the program are as follows:

1. Convert the FORTRAN generated alphanumeric data to the CRT character set.
2. Format the converted alphanumeric data for output to the CRT.
3. Transform the numeric data as described previously.
4. Format the transformed numeric data for output to the CRT.
5. Store the alphanumeric data for future retrieval.
6. Transfer control to the Biomed Console Output Program.

CRTCFP

2.10 X-Y PLOTTER SCALING PROGRAM (XYPSP)

Calling Sequence:

Call XYPSP (JCØN, DATA)

JCØN = The array of control words

DATA = The array of data points (<256 values)

Input: The control word array and the data array.

Output: Plot data is output to the X-Y plotter.

Computations: The X,Y coordinates of each point are computed from the raw data values by the following formula:

$$IY(J)=IFIX (((DATA(I) - AMIN)/DELTA)*INCIN)+.5)$$

where X(I) = the array of raw data values

AMIN = the value associated with the curve's baseline

DELTA= the value of .1 inch displacement of the X-Y plotter

INCIN=the number of plotter increments in .1 inch

AMIN and DELTA are contained in JCØN

INCIN is a constant which must be defined by XYPSP

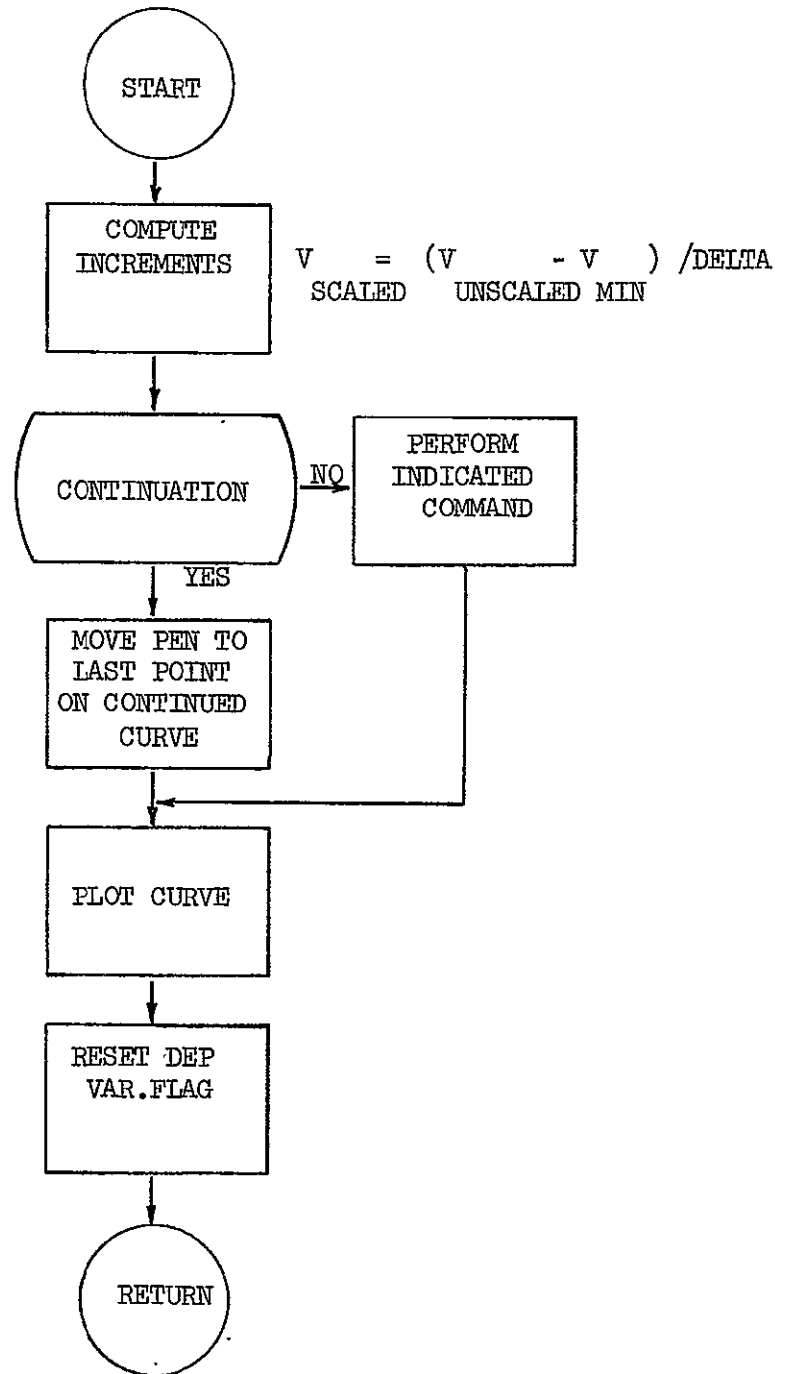
The above transformation is applicable to both the independent variable and the dependent variable.

When both sets of data are acquired by XYPSP,
Description: XYPSP will plot several curves stacked one above the other on the X-Y plotter. It is not necessary for the user to stack the curves if this is not required.

XYPSP will store independent and dependent variable control words and unscaled data point values in their respective arrays as they are transmitted to the program via the calling sequence. The program will assume the independent variable array to have been transmitted when the dependent variable is transmitted. This is necessary to allow several sets of dependent variables to be plotted with respect to one set of independent values. Therefore, data transformation and plotting will be performed when a set of dependent variables has been transmitted to the program.

The plotter commands (see Appendix A) must be performed prior to plotting the data.

After plotting, the last coordinates of each curve must be saved so the curve may be continued.

XYPS

2.11 MAGNETIC TAPE DATA FORMATTER PROGRAM (MTDFP)

Calling Sequence:

```
CALL MTDFP (ICOM, IDATAD)
```

ICOM = command

- = 1 - position tape for next logical file
- = 2 - header record follows
- 3 - data record follows
- 4 - Save current CRT display
- 5 - Put trailer record on tape
- 6 - Find file
- 7 - Rewind tape

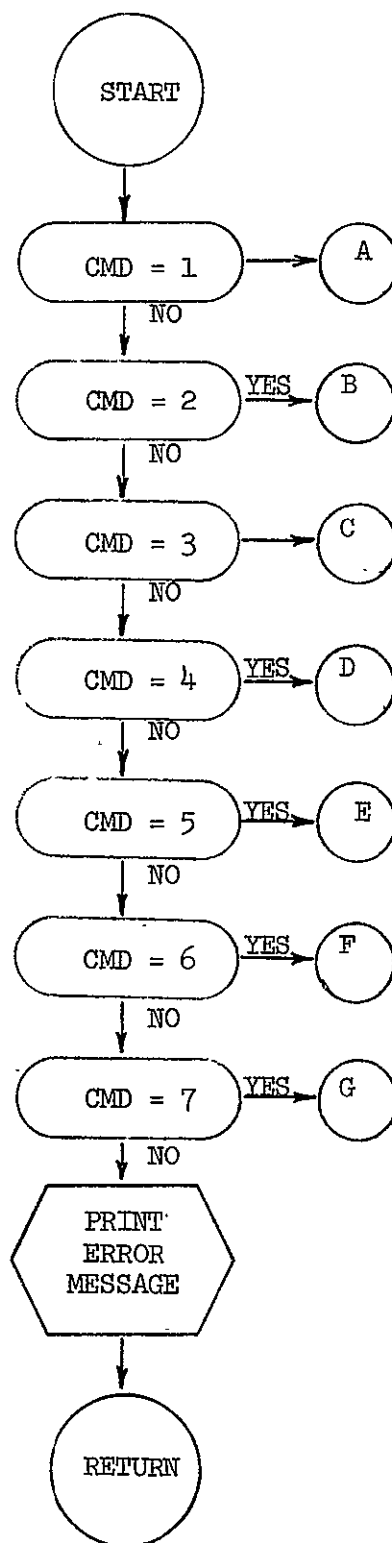
IDATAD = Address of record code word

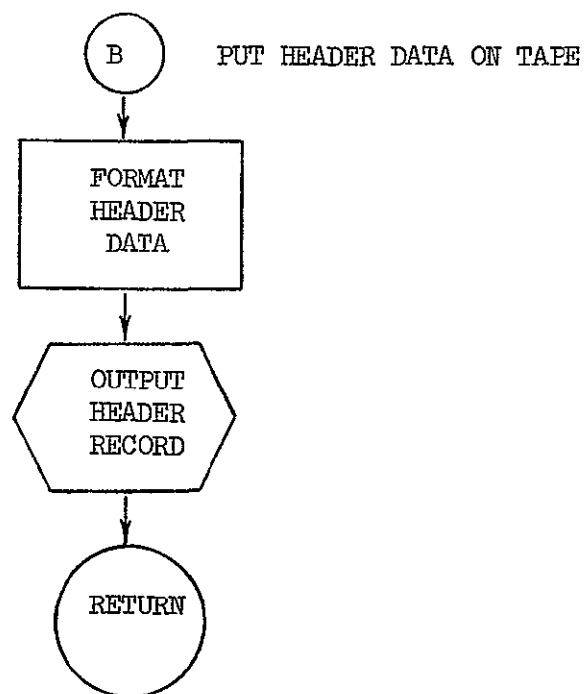
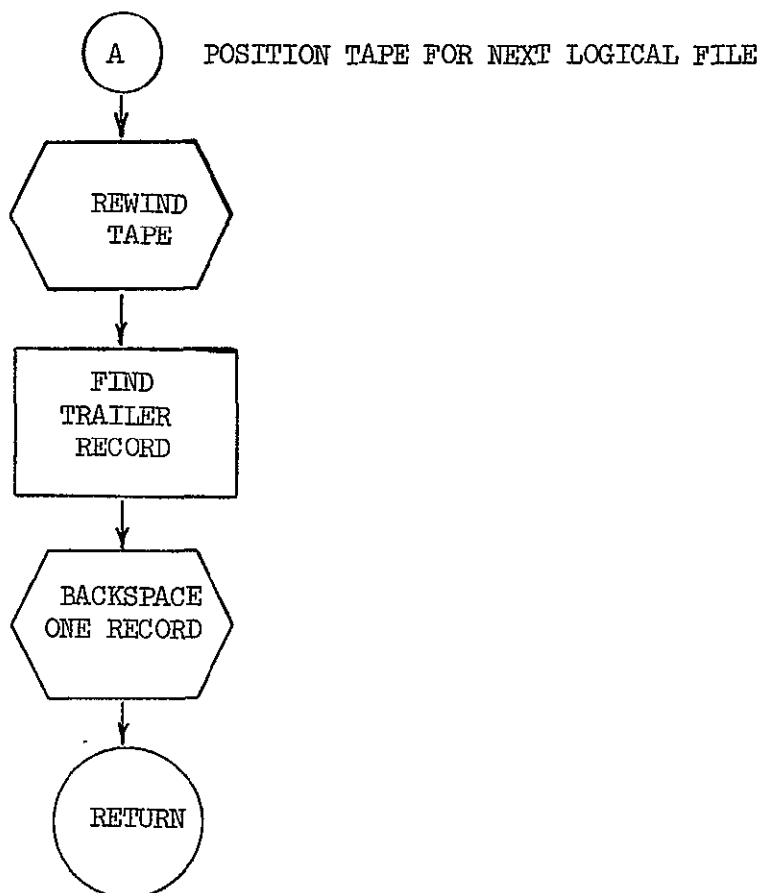
Input: Raw FORTRAN floating point data point values in special format, CRT display data in special format, or data previously formatted for CRT display.

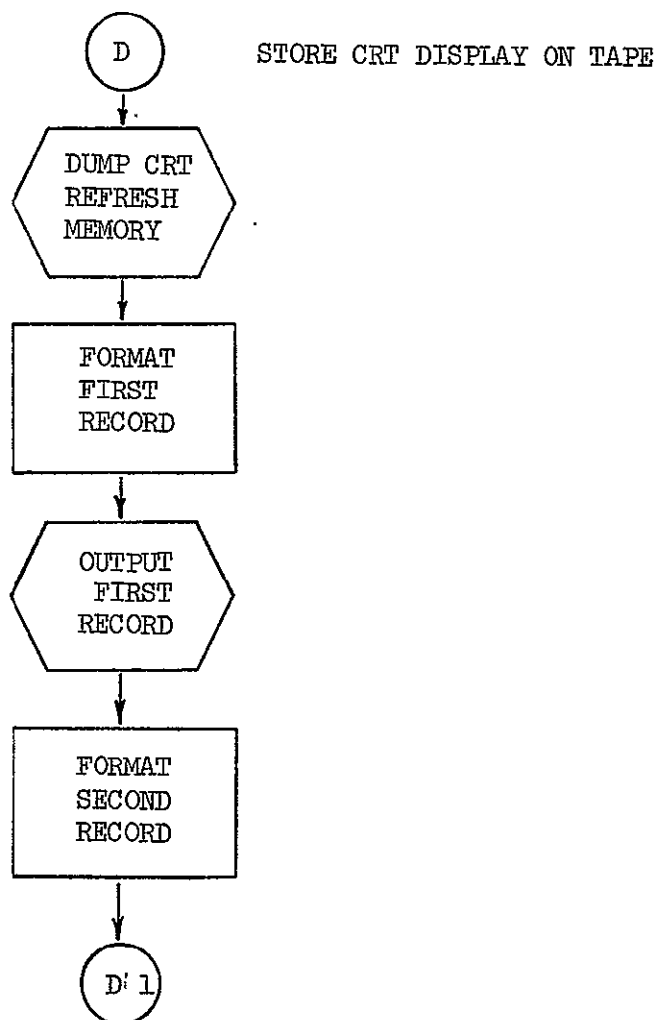
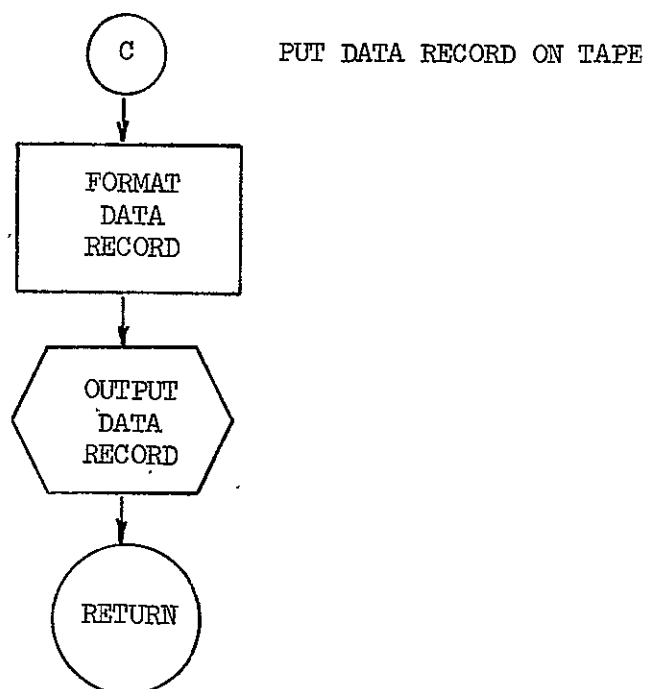
Output: Writes the specified data on magnetic tape.

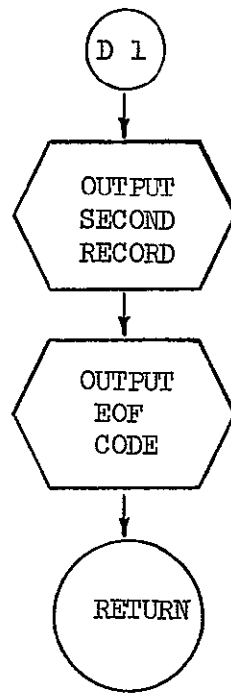
Computations: None

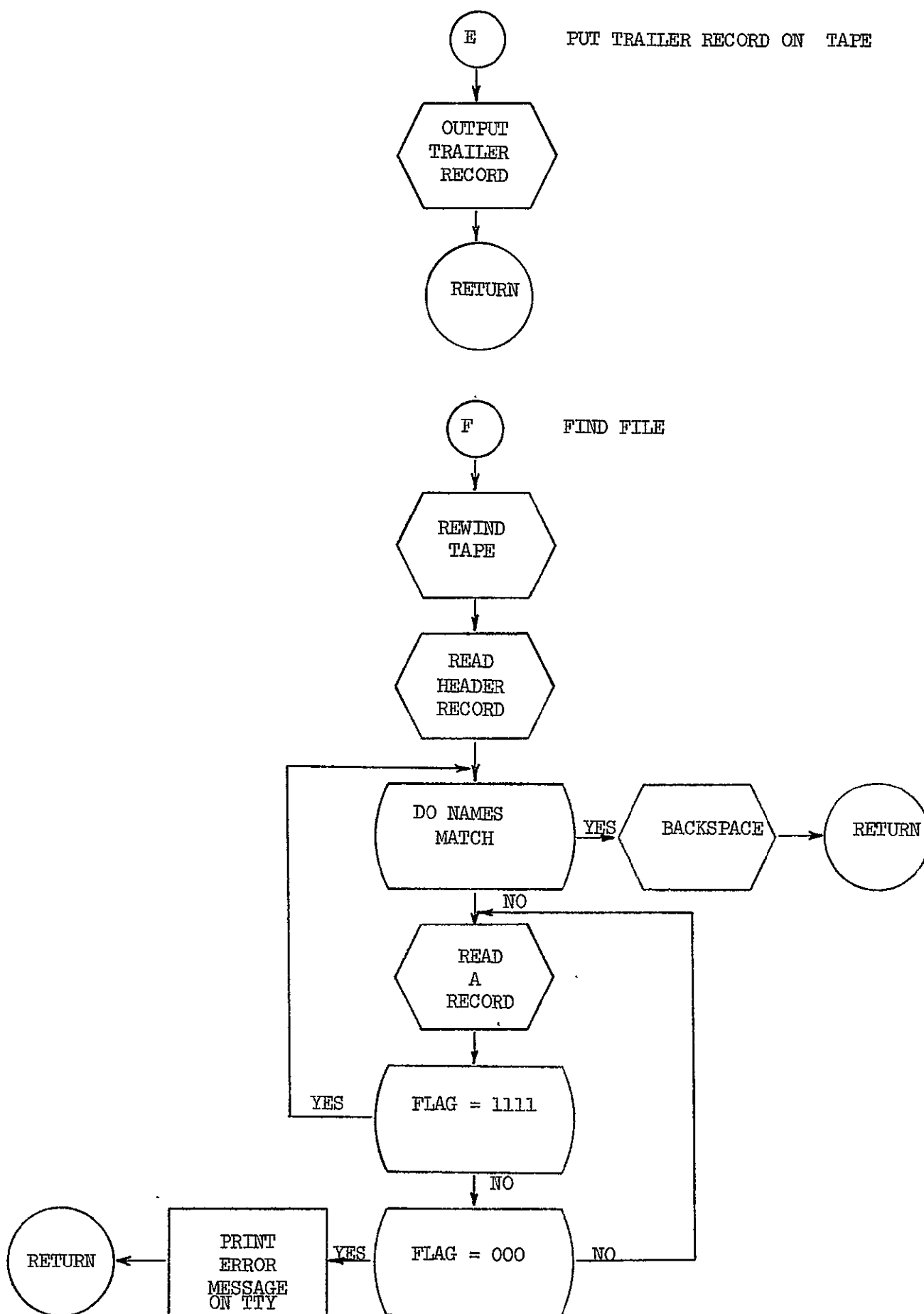
Description: MTDFP will be called by the Keyboard Decoder Program or by an applications program. The data to be stored on mag tape will be formatted as described in Appendix A.

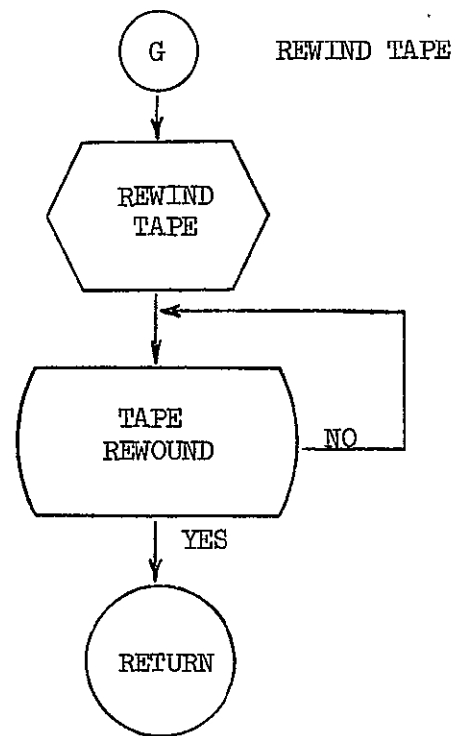
MTDFP











2.12 Triangle Formatter Program (TRIFOR)

Calling Sequence:

CALL TRIFOR (Name)

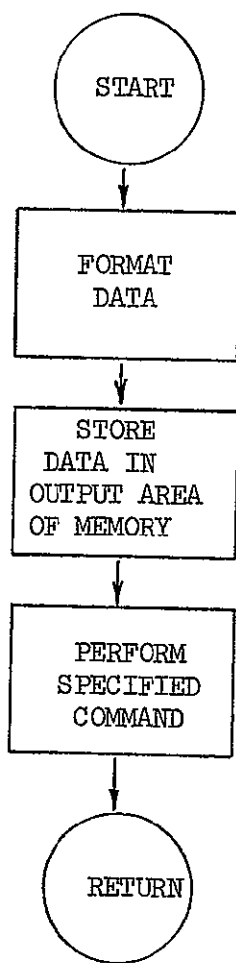
Name = Name of a triangle data array

Input: A FORTRAN generated set of triangle display data

Output: Triangle data to the CRT

Computations: None.

Description: TRIFOR will convert the FORTRAN generated set of triangle data to the proper format for the CRT and store the data in the CRT output area of core memory. TRIFOR will then perform the specified command. See Appendix A for a description of the command words.

TRIFOR

2.13 Event Patch Formatter Program (EPFOR)

Calling Sequence:

```
CALL EPFOR (Name)
```

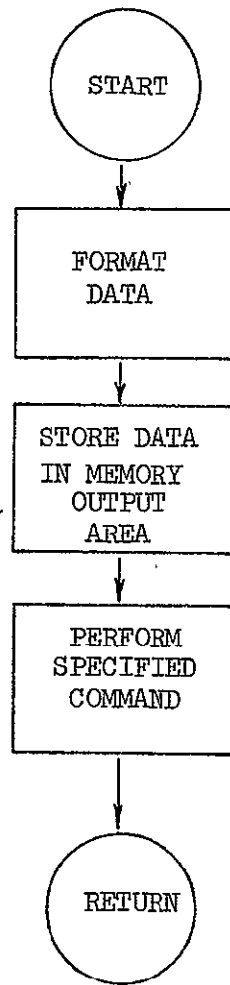
Name = Name of event patch data array

Input: A FORTRAN generated set of data in a special format described in Appendix A.

Output: Event patch display data formatted for output to the CRT.

Computations: None

Description: EPFOR will convert the FORTRAN generated set of event patch data to the proper format for the CRT display and store the data in the CRT output area of core memory. EPFOR will then perform the specified command. See Appendix A.

EPFOR

2.14 CRT Curve Scale Change (CRTSCP)

Calling Sequence:

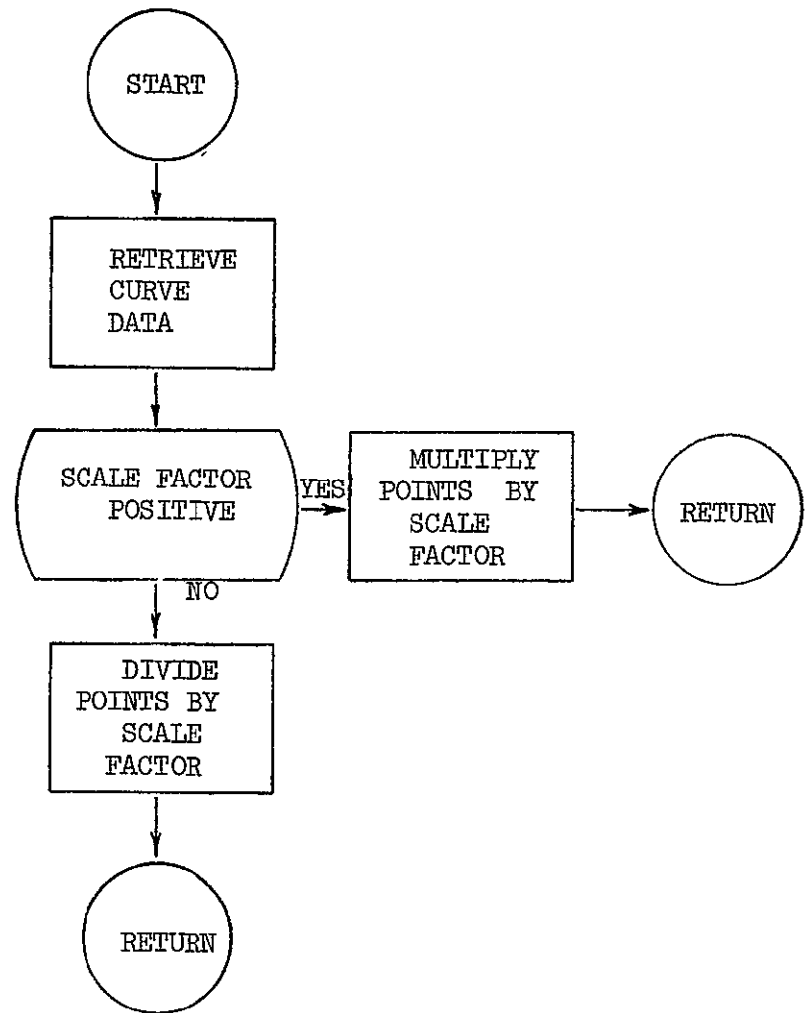
```
RCPYI      1,2  
B          CRTSCP  
(axis to scale: X or Y)  
(scale factor - integer)  
(device - CRT or X-Y plotter)
```

Input: Data previously formatted for CRT display

Output: Re-scaled and formatted data for CRT display

Computations: None

Description: CRTSCP will rescale the already formatted CRT data as specified in the calling sequence. The alphanumeric annotation will not be changed, but the operation may change it from the keyboard.

CRTSCP

2.15 Curve Annotation Retrieval Program (RETANN)

Calling Sequence:

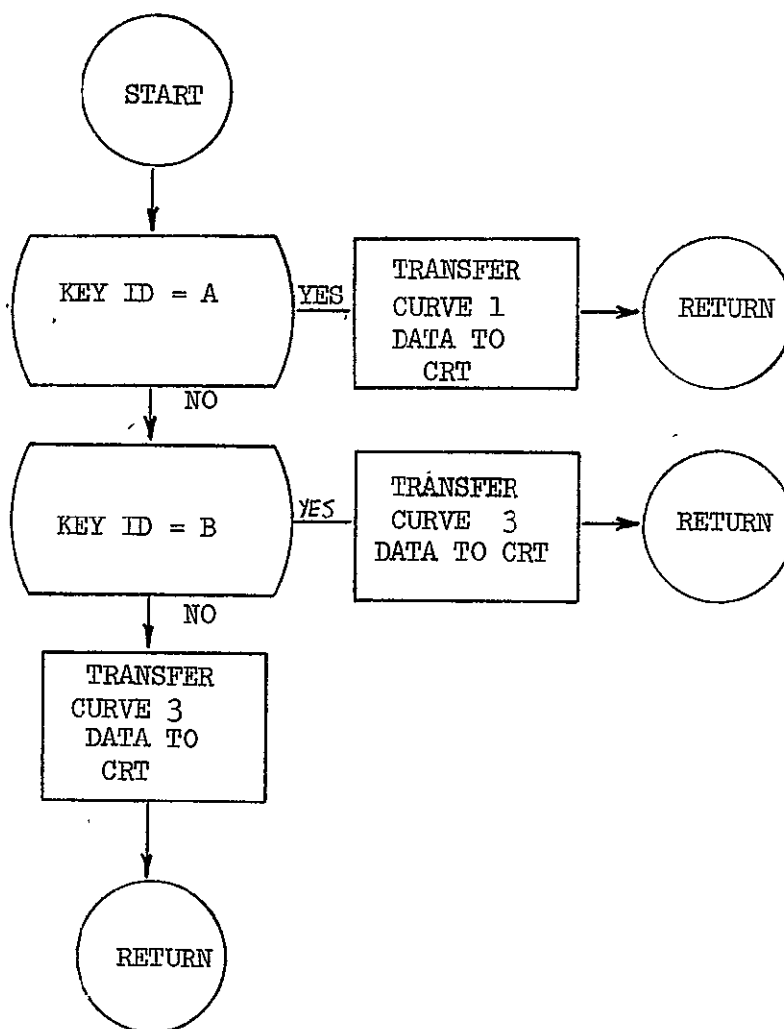
```
RCPYI      1,2  
B          RETANN  
(key identification - A,B, or 18)
```

Input: None

Output: Alphanumeric data already formatted for CRT display.

Computation: None

Description: RETANN will retrieve the already formatted alphanumeric data stored for each curve and cause that data to be output to the CRT.

RETANN

2.15 Meter Bar Formatter Program (MBFOR)

Calling Sequence:

Call MBFOR (Name)

Name = Name of meter bar data array

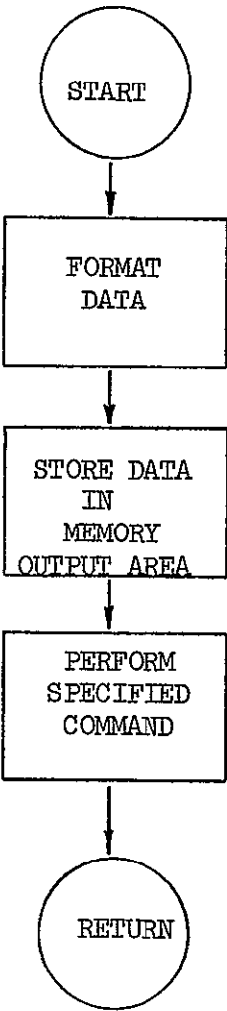
Input: A FORTRAN generated set of data in a special format described in Appendix A.

Output: Meter bar display data formatted for output to the CRT.

Computations: None

Description: MBFOR will convert the FORTRAN generated set of meter bar data to the proper format for CRT display and store the data in the CRT output area of core memory. MBFOR will then perform the specified command. See Appendix A.

MBFOR



2.16 Biomed Console Output Program (CRTXEQ)

Calling Sequence:

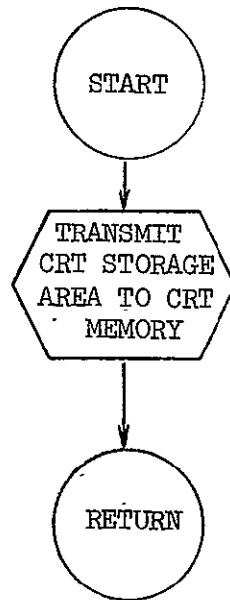
```
RCPYI      1,2
B          CRTXEQ
There are no arguments
```

Input: None

Output: Formatted data for CRT display

Computations: None

Description: CRTXEQ will transfer the data in the CRT output area of core memory to the Biomed Console refresh memory.

CRTXEQ

2.17 Biomed Console Input (CRTIN)

Calling Sequence:

```
RCPYI      1,2
B          CRTIN
There are no arguments
```

Input: Inputs the entire contents of the Biomed Console refresh memory to the input area in core memory.

Output: None

Computations: None

Description: CRTIN will transfer the data in the Biomed Console refresh memory to the input area in core memory.

2.19 RBM Output Programs

Card Reader Input Program

Mag Tape Input Program

Mag Tape Output Program

Disk Input Program

Disk Output Program

Teletype Input Program

All of the above programs are part of the real-time batch monitor and will not be documented in this specification.

4.0 Software Block Diagram

See Appendix C

5.0 Required Input

The input for each program is described in the paragraphs starting with 2.0.

6.0 Program Options

DIDS offers several different display options to the programmer. These options are listed as follows:

CRT (Biomed Console) Displays

1. Display up to three curves of 256 points each
2. Display meter bars
3. Display event patches
4. Display triangle
5. Retrieve CRT displays from mag tape or RAD
6. Plot curves on X-Y plotter
7. Print alphanumerics on X-Y plotter
8. Store data on mag tape
9. Store data on RAD
10. Input data for displays from card reader

Following is a description of the calling sequences for employing the above options:

1. Display up to three curves of 256 points each

Call CRTSP (NAME, AMAX, AMIN, NUM, NA, ICRV, LCØL, RCØL)

NAME = Name of data array to be displayed

AMAX = Maximum value to be displayed

AMIN = Minimum value to be displayed

NUM = Number of points to display ($\leq 256_{10}$)

NA = Name of array containing annotation data

ICRV = Which curve to display (1, 2, or 3)

LCØL = Color associated with first 128 points of curve

RCØL = Color associated with last 128 points of curve

See paragraph 2.8 for a detailed description of the CRT curve scaling program (CRTSP).

2. Display meter bars

Call MBFOR (DATAD)

DATAD = Name of data array

See paragraph 2.15 for a description of the format for the data array

3. Display event patches

Call EPFOR (DATAD)

DATAD = Name of data array

See paragraph 2.13 for a description of the format for the data array.

4. Display Triangle

Call TRIFOR (DATAD)

DATAD = Name of data array

See paragraph 2.12 for a description of the format of the data array.

5. Retrieve CRT displays from mag tape or RAD for mag tape

Call MTURET (Name)

NAME = Ten FORTRAN generated alphanumeric characters naming the saved file

For RAD

Call RADRET (Name)

NAME = Ten FORTRAN generated alphanumeric characters naming the saved file

6. Plot curves on X-Y plotter

Call CRTFSP (NAME, AMAX, AMIN, DEL, IAND)

NAME = Name of data array to be displayed —

AMAX = Maximum value to be displayed

AMIN = Minimum value to be displayed

DEL = Value of 1/10th inch (in engineering units)

IAND = Address of annotation data

See paragraph 2.10 for a description of the formats of the data and alphanumeric arrays.

7. Print alphanumerics on X-Y plotter

Same as above (Option 6).

8. Store data on magnetic tape

Call MTDFP (ICOM, NAME)

ICOM = Command to be performed prior to storing data on mag tape

NAME = Address of data to be stored on mag tape

9. Store data on RAD

Call RADDFP (Name)

NAME = Name of array of data to store on the RAD

10. Input data for displays from card reader

Call CRDRET (ICØUNT, AMAX, AMIN, DELTA, IPLØT)

ICØUNT = Number of values to read from cards

AMAX = Maximum value to plot

AMIN = Minimum value to plot

DELTA = Value of .1 inch on X-Y plotter (if applicable)

IPLØT = 0 - plot on CRT

= 1 - plot on X-Y plotter

7.0 Data Output

None

8.0 Operator Controls

Following is a list which the operator will be capable of exercising along with the keyboard formats. The operator may input control commands from the Biomed Console keyboard or the on-line teletype (operators console).

1. Call a display from magnetic tape

```
CALL name C
P
```

'name' is a ten character name of a file stored in its heater record

C refers to CRT on X-Y plotter as the display device
P

2. Re-record a display on magnetic tape

```
STORE name
```

'name' is a ten character name for the display file

3. Change the alphanumerics of a Biomed Console display

This is a manual operation performed by moving the cursor to the desired character position and entering the proper character(s).

4. Change the scaling of a display.

```
SCALE Up n
Down
```

'Up' - 'Down' indicates whether the newly scaled curve should be larger or smaller than the original.

'n' is an integer representing a new scale factor.

5. Change the color of a display

```
COLOR c l r
```

'c' is a curve number (1, 2, or 3)

'l' is the number representing the left color

'r' is the number representing the right color

0 - Black	4 - Blue
1 - Red	5 - Magenta
2 - Green	6 - Aqua
3 - Yellow	7 - White

6. Verify the operational condition of the display equipment

Biomed Console

6 Continued

Type:

TRI - Displays a triangle pattern
SAW - Displays three sawtooth curves
AN1 - Displays alphanumeric pattern - format 1
AN2 - Displays alphanumeric pattern - format 2
AN3 - Displays alphanumeric pattern - format 3
MBEV - Displays meter bars and event patches

X-Y plotter

Type:

PLOT - Draws a pattern on the X-Y plotter

10.0 Software Interface with Other Programs

Explained in other sections.

11.0 Applicable Available Software

The Symbiant Plotting Package furnished by XDS will be utilized for digital plotting.

12.0 Description of Mathematics to be Performed

None.

13.0 Program Verification

Each operating mode and control mode of the DIDS system will be tested and visually verified to be operating properly.

14.0 Applicable Documents

XEROX ANS FORTRAN IV Language Reference Manual 90 18 06A

XEROX EXTENDED SYMBOL Language and Operations Manual 90 10 52E

XEROX SIGMA 3 Reference Manual 90 15 92C

XEROX Real-Time Batch Monitor (RBM) User's Guide 90 17 85A

XEROX Real-Time Batch Monitor (RBM) Reference Manual 90 10 37F

Note: All of the above named manuals are for the XEROX
SIGMA 3 Computer.

APPENDIX A

MAGNETIC TAPE FORMATS

Word 1	Header Record Flag = 111_{26}	
2	N1	N2
3	N3	N4
4	N5	N6
5	N7	N8
6	N9	N10

Header Record Flag = $111_{26} = 273_{10}$

N1 thru N10 - A ten character name identifying the logical file

Data Identifier

- = 0 - Raw data values in special format
- = 1 - Data already formatted for CRT display

APPENDIX A

MAGNETIC TAPE FORMATS

This appendix describes the formats for display data that is generated by FORTRAN and stored on magnetic tape.

The version of FORTRAN used must be one that generates one word for integers.

One tape may contain several logical "files" of display information. A file must begin with a "header" record. This header record must contain the "name" of the file.

Each data record must be preceded by a control word record that contains six integers (one word each) and 3 real numbers (two words each). This control word record must always be twelve computer words long, even though some of the words are not required in some cases.

A trailer record signals the end of each display file. When the trailer record is read from tape, program control is returned to the executive.

APPENDIX A MAGNETIC TAPE FORMATS

HEADER RECORD

Entry 1	Header Record Flag = 111_{16}	
2	N1	N2
3	N3	N4
4	N5	N6
5	N7	N8
6	N9	N10
7	Data Identifier	

Header Record Flag = 111_{16} = 273_{10}

N1 thru N10 - A ten character name identifying the logical file

Data Identifier

- = 0 - Raw data values in special format
- = 1 - Data already formatted for CRT display

ALPHANUMERIC DATA RECORDS

Control Word Record	Entry 1	Code Word	10
	2	Command	
	3	Plotter/CRT	
	4	Line No.	
	5	Character No.	
	6	No. Characters	
	7	Format Code/Space Count	
	8	Character Size	
	9	Not Used	

Data Word Record	Entry 1	Char 1	Char 2
	15	Char 29	Char 30

Code Word = 10

Command

- = 0 - Continue
- = 1 - Move number of spaces specified in word 7
- = 2 - Move pen to line 1
- = 3 - Set origin at current point

Plotter/CRT

- = 0 - Display on plotter
- = 1 - Display on CRT

Line No.

for CRT - The number of the CRT line on which to display the data. Line 1 is the top line.

for X-Y plotter - The number of the graph line (at 10 per inch) to display the data. Line 1 is 1/2 inch above top grid line.

Character No.

for CRT - a number in the range 1 thru 30 specifying the first character position for the alphanumeric data.

for X-Y Plotter - a value specifying the number of graph squares (each square is 1/10 inch square) from the line Y = 0 for the first character position for the alphanumeric data. This number may be negative.

Format Code/Space Count

Format Code - a value specifying the desired format for the alphanumeric data to be displayed on the CRT.

Space Count - The number of spaces (1/10 inch per space) to move the paper from the present position.

No. Characters - The number of characters in the record.

Character Size - An integer which is an even multiple of .07 inch.

CURVE DATA

Control Word Record	Entry 1	Code Word	20-22	Fixed Point
	2	Command		
	3	Plotter/CRT		
	4	Curve No. /Line No.		
	5	No. Points to Display		
	6	Color/Curve ID		
	7	Max. Value		Floating Point
	8	Min. Value		
	9	Delta/Independent Constant		

Data Point Record	Entry 1	Point 1	
	2	Point 2	
	...		
	256	Point 256	

Code Word

- = 20 - This vector is the dependent variable
- = 21 - This vector is the independent variable - variable values
- = 22 - This vector is the independent variable - constant values

If the code word is 22 - control words 4 thru 8 will be ignored. The value of the constant dependent variable should be stored in control word 9.

Command

- = 0 - Continue
- = 1 - New curve oriented to old Y=0 line
- = 2 - Set new Y=0 line before plotting - Do not draw line
- = 3 - Set new Y=0 line before plotting - Draw line
- = 4 - Wait

Plotter/CRT

- = 0 - Plot on X-Y plotter
- = 1 - Plot on CRT

Curve No./Line No.**for CRT**

- = 1 - Plot on CRT curve 1
- = 2 - Plot on CRT curve 2
- = 3 - Plot on CRT curve 3

for X-Y plotter

- = 1 thru 110 - Specifies which line on the plotter paper is associated with the minimum data value defined for the curve. Top line = 1

Max Value - Maximum floating point value in the vector

Min Value - Minimum floating point value in the vector

Delta - The value associated with 1/10th displacement on the graph paper.

No. Points to Display - The number of data points in this record.

Color/Curve ID

Color - This has meaning only if the curve is to be displayed on the CRT. The field specifies the color of the left and right halves of the curve. The left color is in the high order byte and the right color is in the low order byte. Colors are:

- | | |
|------------|-------------|
| 0 - Black | 4 - Blue |
| 1 - Red | 5 - Magenta |
| 2 - Green | 6 - Aqua |
| 3 - Yellow | 7 - White |

Point Values - FORTRAN generated floating point data point values. A maximum of 256₁₀ data point values are allowable per record.

TRIANGLE DATA

Control Word Record	Entry 1	Code Word	40	Not Used
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			

Data Word Record	Entry 1	Line No.		
	2	Left Color	Color Change	1
	3	Right Color		
	22	Line No.		
	23	Left Color	Color Change	8
	24	Right Color		

This is for CRT display only.

Each triangle display requires eight color changes.

No line numbers may be the same.

All entries in the data word record are FORTRAN generated integers.

EVENT PATCH DATA

Control Word Record	Entry 1	Code Word	50	Not Used
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			

Data Word Record	Entry 1	Line No.
	2	Right Color
	3	Center Color
	4	Left Color

Color Codes

0 - Black	4 - Blue
1 - Red	5 - Magenta
2 - Green	6 - Aqua
3 - Yellow	7 - White

This record is for CRT display only.

Each data word record must be preceded by a control word record.

METER BAR DATA

Control Word Record	Entry 1	Code Word	60	Not Used
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			

Line No.
Color
Value

This record is for CRT display only.

Color Codes

0 - Hardware supplies color based on the associated value.

1 - Red	4 - Blue
2 - Green	5 - Magenta
3 - Yellow	6 - Aqua
	7 - White

Any non-zero color code will override the hardware color generation.

'Value' must be in the range 0 - 256

TRAILER RECORD

Flag = 999_{16}
Flag = 999_{16}
~
Flag = 999_{16}

$$999_{16} = 2457_{10}$$

This must be the record after the last logical file.

EXECUTE CRT DISPLAY RECORD

Entry 1	Code Word	60	
2			
3			
4			
5			Not Used
6			
7			
8			
9			

Causes the CRT display data stored in Sigma 3 memory to be displayed on the CRT.

CLEAR CRT RECORD

Entry 1	Code Word	70	
2			
3			
4			
5			
6			Not Used
7			
8			
9			

Causes the CRT to be cleared of all displays.

APPENDIX B

DISK FØRMAT

To be supplied.

DATA INTEGRATION AND DISPLAY SYSTEM
FUNCTIONAL BLOCK DIAGRAM
APPENDIX C

HARDWARE

- Teletype Keyboard
- Biomed Console Keyboard
- Biomed Console Refresh Memory
- CRT
- Digital X-Y Plotter
- Disk
- Mag Tape
- Card Reader

SOFTWARE

- Teletype Input Program
- Input teletype characters
- Biomed Console Input Program
- Input a full page from the CRT
- Biomed Console Output Program
- Output a full page to the CRT
- Curve Formatter Program
- Format curve data for CRT display
- Triangle Formatter Program
- Format triangle data for CRT display
- Event Patch-Meter Bar Formatter Program
- Format event patch-meter bar data for CRT display
- X-Y Plotter Output Program
- Output data to X-Y Plotter
- X-Y Plotter Scaling Program
- 1. Compute increments for plotter
- 2. Scale data
- 3. Format scaled data for output
- Disk Input Program
- Input data from disk storage
- Disk Output Program
- Output data for disk storage
- Mag Tape Input Program
- Input data from mag tape
- Mag Tape Output Program
- Output data for mag tape storage
- Card Reader Input Program
- Input data from card reader
- Card Reader Data Retrieval Program
- 1. Retrieve required data from card reader
- 2. Store data points
- 3. Store alphanumerics
- CRT Data Retrieval Program
- Retrieve required data from CRT
- CRT Curve Scaling Program
- Scale curve data
- CRT Curve Scale Change Program
- Change scale of displayed CRT curve
- Curve Annotation Retrieval Program
- 1. Retrieve data for specified curve
- 2. Store data in output area
- Keyboard Decoder Program
- 1. Decode command
- 2. Set flags indicating source and destination of data
- 3. Transfer control to proper program
- Executive Loop Program
- 1. Monitor teletype and CRT Keyboard for command
- 2. Transfer control to Keyboard Decoder Program

DATA PATH (Solid line)

CONTROL PATH (Dashed line)